One object of the present invention is to provide a Braille display system which has a rapid refresh rate of the Braille dots.

Another object of the present invention is to provide a refreshable Braille display system that has the ability to conveniently present text, spreadsheet and database information, technical material and information in tabular or columnar format to visually impaired persons.

Still another object of the present invention is to provide a refreshable Braille display that allows a user to access links or subdirectories without removing their hands from the display surface.

Still another object of the present invention is to provide a modular Braille display system that is flexible so that it can be sized and arranged to fit a user's needs.

Still another object of the present invention is to provide a Braille display system which is modular and therefore, quickly and easily assembled or repaired.

Still another object of the present invention is to provide a Braille display system which can present text and limited graphics, normally displayed on a computer display terminal or CRT, to a visually impaired person.

Still another object of the present invention is to provide a Braille display system that has a tactile surface with no holes, gaps or voids, and provides a continuous uninterrupted tactile reading surface for the user eliminating any interference with reading of Braille characters and preventing environmental damage to the underlying Braille display hardware.

Accordingly, the present invention relates to a refreshable Braille display; comprising a plurality of Braille dots that extend and retract, arranged in Braille characters such that the Braille dots are operable as a personal computer monitor to allow a blind person to discern the information displayed thereon by reading the Braille characters. At least one microelectromechanical device operably connects to the Braille dots such that the Braille dots retract and extend based upon the operation of the microelectromechanical device. The Braille character comprises six or eight Braille dots. Multiple Braille characters are arranged in functionally independent modules of rows and columns. The microelectromechanical device operates electrostatically or comprises shape memory alloy material. The microelectromechanical device will either directly move a pin or directly form the individual Braille dots, or it will pneumatically move a pin or directly form a Braille dot.

In another aspect, the present invention relates to a refreshable Braille display; comprising a housing; a plurality of Braille dots arranged in Braille characters mounted in the housing; at least one microelectromechanical device operably attached to each Braille dot; a compressor which provides air pressure to the microelectromechanical devices; a microcontroller mounted in the housing and programmed to directly control the operation of the microelectromechanical devices to extend and retract the Braille dots; a personal computer programmed with Braille translation software and connected to the microcontroller. The information and data from the personal computer is translated and transferred to the microcontroller. The microcontroller operates the microelectromechanical device in response thereto which extends and retracts the Braille dots allowing a blind person to discern the information displayed thereon by reading the Braille characters formed by the extended Braille dots.

In yet another aspect, the present invention relates to a refreshable Braille display system, comprising a housing; at least one module mounted in the housing, and a top surface sealed to the housing and the modules. The top surface is an elastomeric material and is selectively deformable. At least one microelectromechanical device is mounted in the module such that the microelectromechanical device selectively deforms the top surface by forming dimples therein. The dimples function as Braille dots and form Braille characters. The microelectromechanical device selectively flattens the dimple thereby removing the Braille dot and thereby changing or removing the Braille character. The Braille dots and the Braille characters form a Braille display. A module microcontroller controls the microelectromechanical device. A microcontroller coordinates each individual module microcontroller and communicates with the computer. A personal computer programmed with Braille translation software connects to the microcontroller such that information and data from the personal computer is translated and transferred to the microcontroller. The microcontroller or the module microcontrollers operate the microelectromechanical devices in response thereto which forms the Braille dots allowing a blind person to discern the information displayed thereon by reading the Braille characters formed by the Braille dots.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

Further features of the present invention will become apparent to those skilled in the art to which the present invention relates from reading the following specification with reference to the accompanying drawings in which:

FIG. **1** is a view of the present invention.

FIG. **2** is a layout of the module showing Braille characters.

FIG. **3** is a view of the section cut along lines **2**—**2** on FIG. **2**.

FIG. **4** is a block diagram of the control function of a single module of the present invention.

FIGS. **5**A and **5**B are detail views of a MEMS device and Braille dot extended and retracted, respectively

FIG. **6** a schematic representation of the Braille dots actuation scheme.

FIG.**7** is another design for the MEMS device utilizing an actuator based upon a sliding element.

FIGS. **8**A, and **8**B are details of a MEMS devices that directly actuates a Braille dot using a thin film SMA element.

FIGS. **9**A, and **9**B are details of a MEMS device that directly forms the Braille dot using a thin film SMA element.

FIGS. **10**A, and **10**B are details of a MEMS device that directly forms the Braille dot using a thin film SMA element.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawings and, more particularly, to FIG. **1** there is shown a view of the present invention. A Braille display **2** comprises Braille dots **20** arranged into Braille characters **14**. Although, each Braille character **14** requires only six Braille dots **20**, the Braille character **14** of the present invention is preferably comprised of eight Braille dots **20**. The two extra Braille dots **20**, (by convention referred to as Braille dots **7** and **8**) are used to highlight text within a document such as hyperlinks, boldface or italicized text. The Braille characters **14** are arranged in modules **18**. In this embodiment of the present invention, the Braille characters in each module are arranged in two rows and